



# Water and Sustainability – The EPRI Research Plan

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Carns

Water & Sustainability Workshop  
Washington, DC

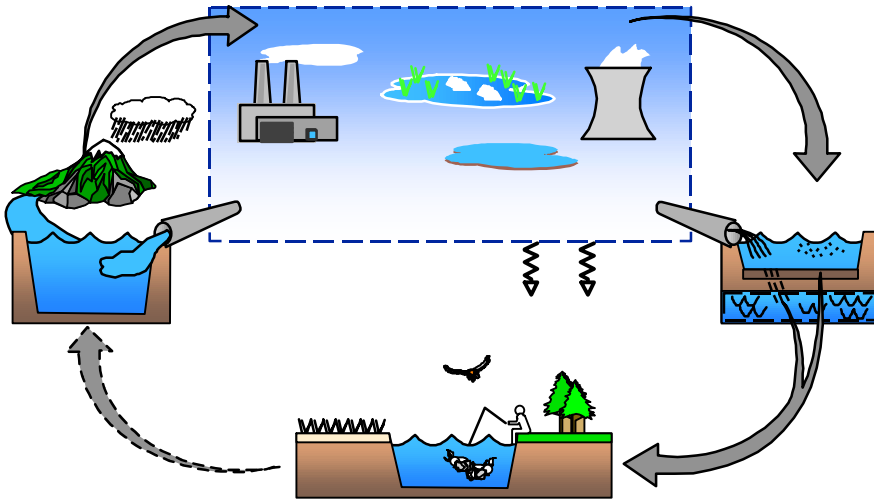
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# Issues

- Fast growing demand for clean, fresh water
- All regions of US vulnerable to water shortages
- Environmental protection and enhancement
- Dependency of electricity supply and demand on water availability
- Curtailed future growth of electricity demand
- Shortages of current electricity supply
- Electricity grid topology
- Societal and economic sustainability; Electricity Technology Roadmap



# Objectives



- Mitigate limitations on economic development and electricity supply & demand caused by water supply/treatment restrictions
- While enhancing and protecting water resource environmental values
- Using EPRI water resource management tools and technology

# Approach



- Create and apply
  - Watershed management (macroscale) planning tools
  - Individual facility (microscale) water management planning tools
  - New water management technologies (microscale)
  - Frameworks for integrating macro and micro scale planning and technology applications

# Macroscale Elements

- Water resource management tools
  - Watershed/Ecosystem models
  - Waterbody models
  - Ecological population/community models
- Eco-asset management
- Eco-currency (e.g., Water quality trading)
- GIS planning tools
- Water availability and demand projection tools



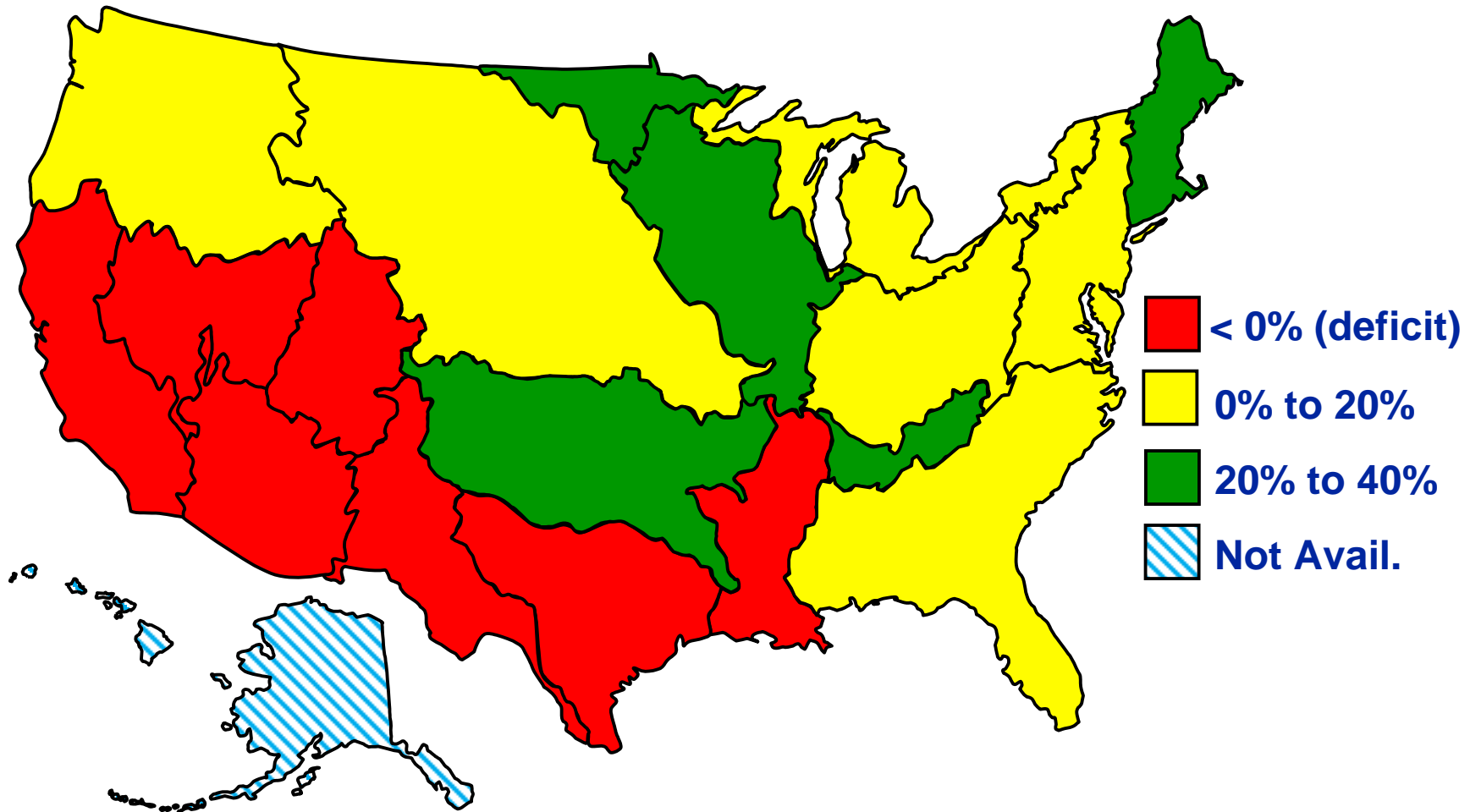
# Microscale Elements

- Advanced cooling technologies
- Gray water technologies
- Water intake technologies
- Membranes
- Photocatalytic technologies
- Pinch analyses
- Ozone
- Freeze-thaw
- Enhanced Biotreatment
- Desalination
- UV



# W&S Results -- There Will Be A Problem

“Generalized Water Budget” by USGS Region for Dry Year—2040



# W&S Results – Cooling Water Withdrawal and Consumption (Evap.) Rates for Common Thermal Power Plant/Cooling System Types

Plant and Cooling System Type	Water Withdrawal (gal/MWh)	Typical Water Consumption (gal/MWh)
Fossil/biomass/waste-fueled steam, once-through cooling	20,000 to 50,000	~300
Fossil/biomass/waste-fueled steam, pond cooling	300 to 600	300-480
Fossil/biomass/waste-fueled steam, cooling towers	500 to 600	~480
Nuclear steam, once-through cooling	25,000 to 60,000	~400
Nuclear steam, pond cooling	500 to 1100	400-720
Nuclear steam, cooling towers	800 to 1100	~720
Natural gas/oil combined-cycle, once-through cooling	7500 to 20,000	~100
Natural gas/oil combined-cycle, cooling towers	~230	~180
Natural gas/oil combined-cycle, dry cooling	~0	~0
Coal/petroleum residuum-fueled combined-cycle, cooling towers	~380*	~200

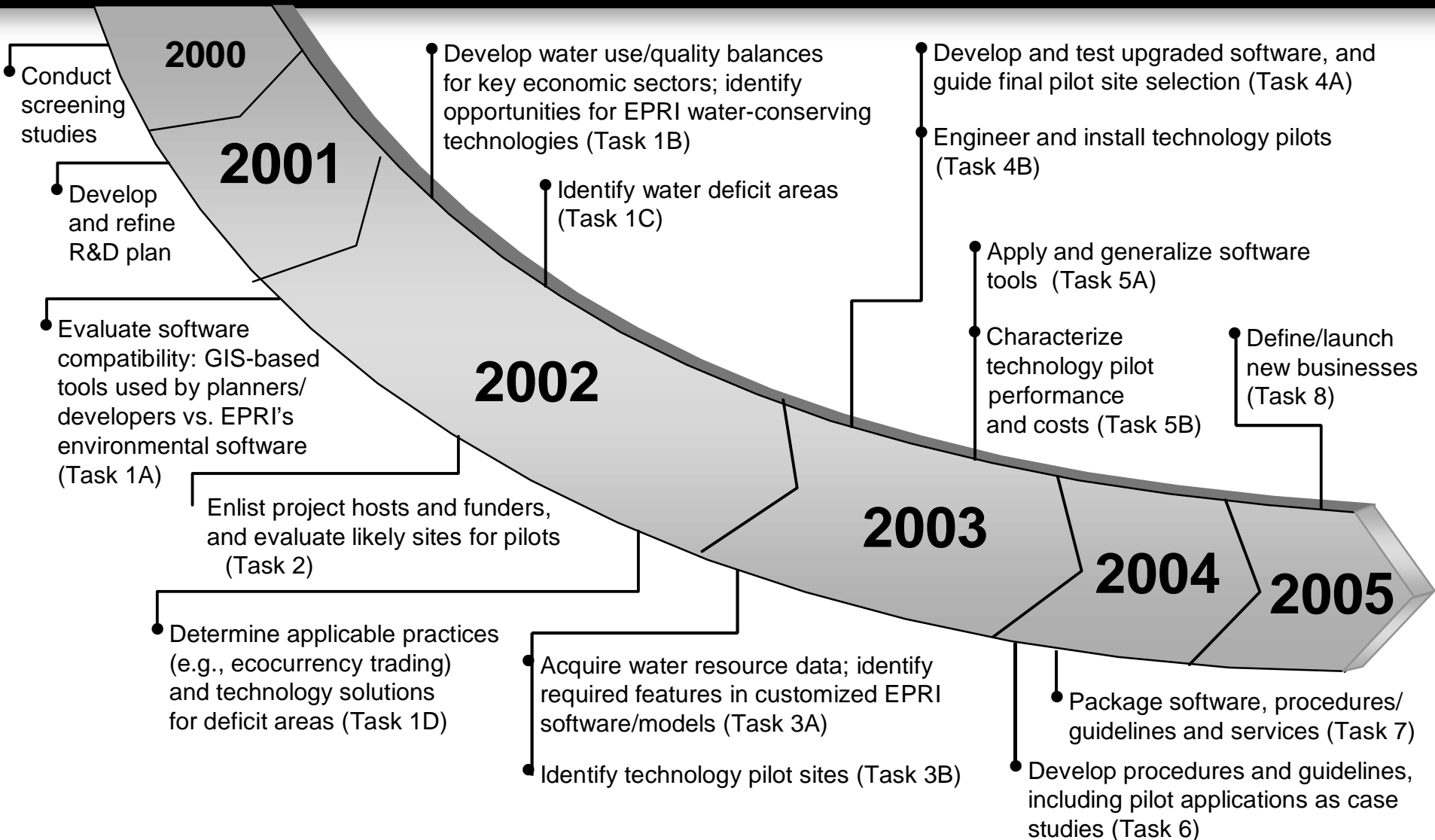
\* includes gasification process water



# W&S Results – Unit Energy (Electric) Consumption for Water Supply and Wastewater Treatment

Sector	Surface Water	Ground Water	Wastewater
kWh/Million gallons			
Domestic	-NA-	700	-NA-
Commercial	300	700	2500
Industrial	300	750	2500
Mining	300	750	2500
Irrigation	300	700	-NA-
Livestock	300	700	-NA-
Power Generation	300	800	-NA-
Public Supply (includes wide area distribution)	1406	1824	-NA-
Publicly Owned Treatment Works (typical)	trickling filter		955
	activated sludge		1,322
	advanced wastewater treatment		1,541
	advanced treatment with nitrification		1,911

# Water and Sustainability— Research Plan Schedule



# Water and Sustainability— Research Plan Project Tasks (1)

- 1A. Macroscale:** Conduct detailed evaluation of fit between GIS-based software tools used by planners and developers and EPRI's WARMF, SmartPlaces, and other software
- 1B. Microscale:** Develop water use/quality balances for industries, agriculture, healthcare, electric grid, and generators; cross-reference them with EPRI water-conserving technologies
- 1C. Macroscale:** Identify (PINCH) metropolitan area or subregional water deficit locales (USGS water resource regions are too broad)
- 1D. Macro- and Microscale:** Determine applicable practices (e.g., eco-value trading and electricity impacts) and technology solutions for each deficit area. Assure the compatibility of macro- and microscale impacts, including generation/power delivery planning model results.

# Water and Sustainability— Research Plan Project Tasks (2)

**2A.** Enlist potential project hosts and funders

**2B.** **Macro- and Microscale:** Perform site evaluations of the technology application opportunities identified in Task 1

**3A.** **Macroscale:** Acquire water resource data, and identify required features in customized EPRI software/models

**3B.** **Macro- and Microscale:** Identify a select number of potential pilot sites that should optimize the macro/ microscale impacts

**4A.** **Macroscale:** Develop macroscale software to guide to the final determination of the pilot sites, and to evaluate the results of the pilots

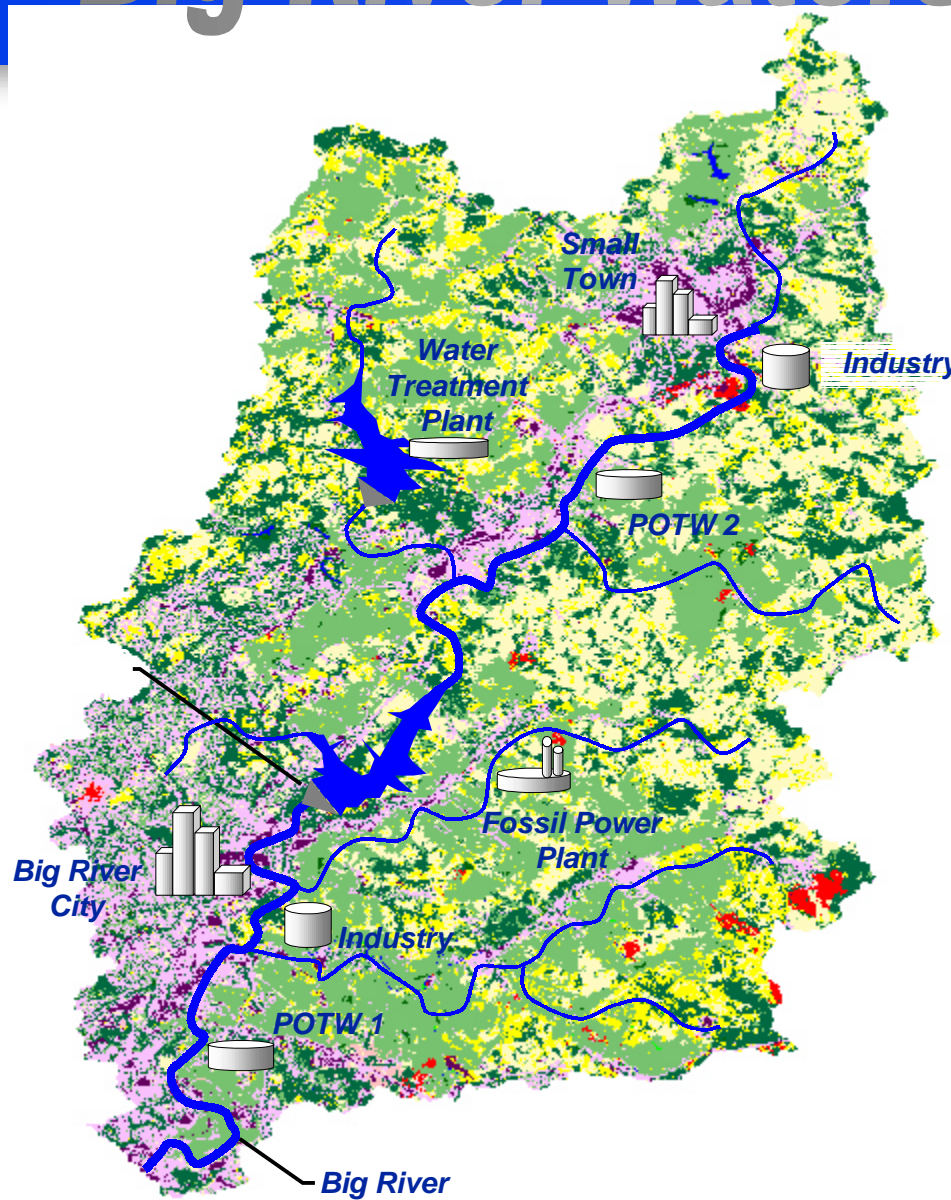
**4B.** **Microscale:** Engineer and install technology pilots

# Water and Sustainability— Research Plan Project Tasks (3)

- 5A. Macroscale:** Generalize software tools based on pilot results, and promote their widespread application
- 5B. Microscale:** Characterize technology pilot performance and costs for general use by others
- 6. Microscale:** Develop procedures and guidelines manuals; use pilot applications as case studies
- 7.** Package software, procedures/guidelines manuals, and services for widespread use
- 8.** Define and launch new businesses that capitalize on this work and EPRI's general research program

# Macroscale/Microscale Interdependencies

## Big River Watershed



### Land Use Legend

- Water
- Low Intensity Development
- High Intensity Development
- Pasture
- Row Crops
- Evergreen Forest
- Deciduous Forest
- Wetlands
- Mines

# Water Sustainability Workshop



- July 25, 2002
- EPRI Washington DC Headquarters
- Water and energy experts, project hosts, and funders
- Purpose
  - Critique strawman research plan
  - Establish consensus research priorities
  - Evaluate likely sites for regional pilot projects

... and above all

***Devise a compelling  
initiative with a  
programmatic theme that  
captures the imagination!***